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Euglenophyceae from bromeliad phytotelmata: new records for Bahia state and Brazil

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Abstract

We report 7 new records of Euglenophyceae for Bahia state and 1 for Brazil. The material was collected from bromeliad phytotelmata in 4 areas of Bahia state (Serra da Jiboia, Parque das Dunas, Fazenda Itaberaba, and Reserva Sapiranga) during 14 months from 2014 to 2016. For each species, we provide the description, geographical distribution in Brazil, microhabitat conditions, and frequency of occurrence. The richness was greatest in bromeliads in the Serra da Jiboia (5 species), followed by the Parque das Dunas (3 species), Reserva Sapiranga (2 species), and Fazenda Itaberaba (1 species).

Key words

Bromeliaceae; Euglenophyta; floristics; microhabitats; taxonomy.

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Introduction

Phytotelmata are aquatic habitats formed in cavities of terrestrial plants, the bromeliads being one of the main representatives of this type of environment in the Neotropical Region (Varga 1928). Among the several organisms associated to this type of microhabitat, the algae are essential for the dynamics of the phytotelmata community, especially in areas exposed to high solar irradiance.

The class Euglenophyceae are unicellular; rarely colonial; flagellate; and autotrophic, mixotrophic, or heterotrophic organisms with variable morphology that usually inhabit freshwater bodies, especially shallow environments rich in organic matter (Round 1983, Wetzel 2001, Boudouresque 2015). Little is known about euglenophyte diversity in phytotelmata from Brazil; information is restricted to only 2 studies: Kolkwitz (1933), who reported *Phacus pleuronectes* (O.F. Müller) Nitzsch ex Dujardin inhabiting phytotelmata of *Nidularium* sp. in Cabo Frio (RJ) and Duarte et al. (2013), who evaluated the relationship between the diameter and volume of water in the phytotelma of *Aechmea distichantha* Lemmermann and the abundance of flagellate organisms found in phytotelmata in the upper Paraná river basin.

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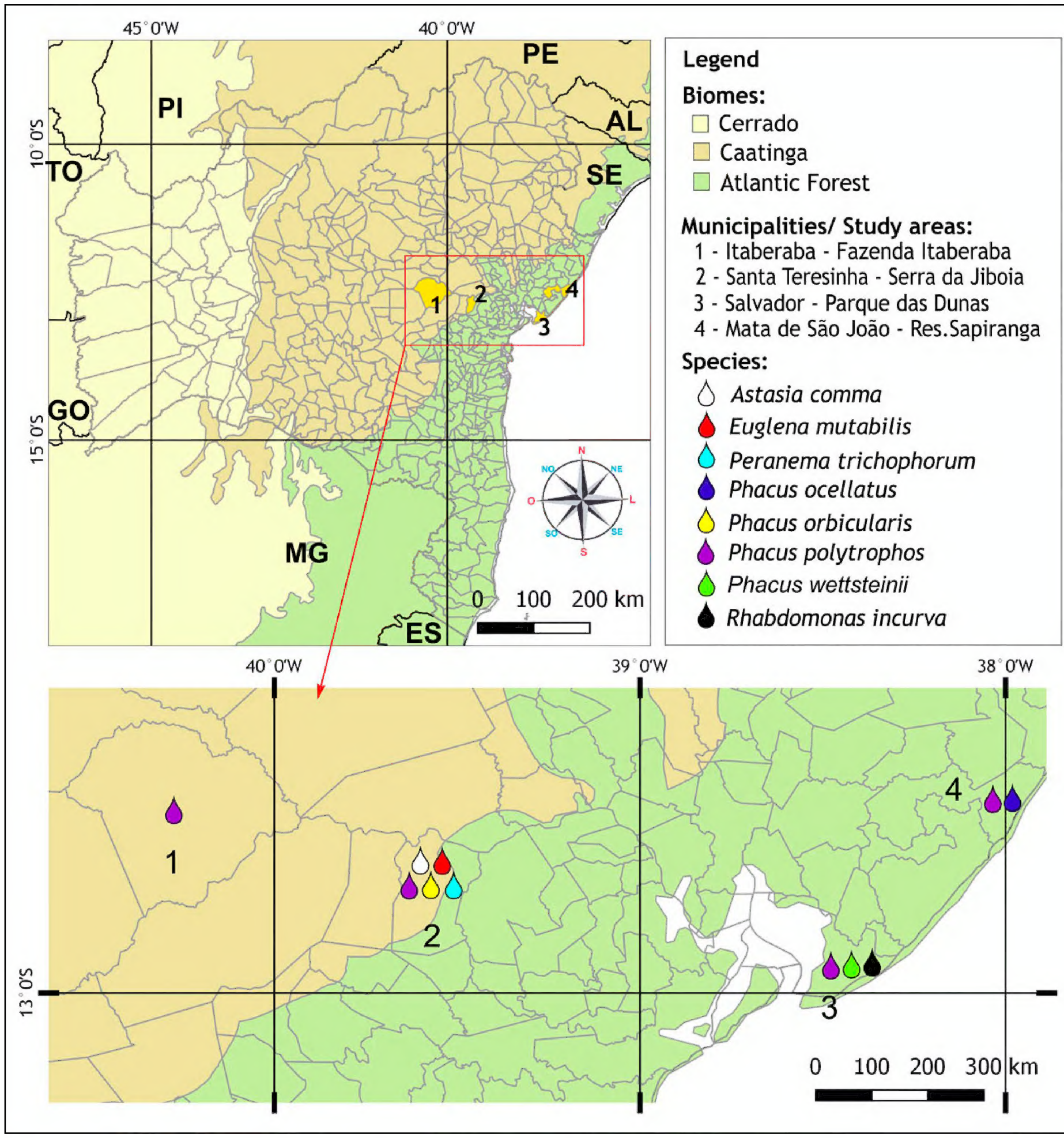

Figure 1. Location of study areas and geographical distribution of new Euglenophyceae records in Bahia state, Brazil.

Euglenophyceae representatives have also been reported in bromeliad phytotelmata in other countries such as *Euglena* Ehrenberg, *Menoidium* Perty, *Phacus* Dujardin, and *Astasia* Dujardin in French Guiana (Brouard et al. 2011, Carrias et al. 2014), the genus *Trachelomonas* in Jamaica (Laessle 1961), and *Euglena variablis* Klebs, as sole representative, in Mexico (Hernandez-Rodriguez 2014).

In Bahia state, there are no records of the occurrence of Euglenophyceae in bromeliad phytotelmata and taxonomic studies of the group are uncommon. Here, we report 8 new records of euglenoid organisms for Bahia state occurring in bromeliad phytotelmata from 4 areas, highlighting their morphological characteristics as well as frequency of occurrence and the microhabitat conditions under which the species are found.

Methods

The study was carried out in 4 areas of Bahia state, northeast Brazil: Serra da Jiboia (12°51′ S, 039°28′ W), municipality of Santa Teresinha, area of rocky outcrops; Parque das Dunas (12°55′ S, 038°19′ W), municipality of Salvador, Restinga area; Fazenda Itaberaba (12°30′ S, 040°04′W), municipality of Itaberaba, Caatinga area; and Reserva Sapiranga (12°33′ S, 038°02′ W), municipality of Mata de São João, area of Atlantic Forest (Fig. 1).

The material examined was collected randomly in phytotelmata of 4 species of bromeliads: *Alcantarea nahoumii* (Leme) J.R.Grant (Serra da Jiboia), *Hohenbergia littoralis* L.B.Smith. (Parque das Dunas), *Aechmea* cf. *lingulatoides* Leme & H.Luther (Fazenda Itaberaba), and *Hohenbergia stellata* Schult. & Schult.f. (Reserva

Sapiranga). The bromeliads sampled were choose based on a raffle through a die. Each side indicated the direction to follow to the next bromeliad to be collected: 1, North; 2, East; 3, West; 4, South; 5 and 6, irrelevant. After the raffle, we proceeded to the next bromeliad based on compass indication. The distance between a sampled bromeliad and the next one was at least 5 m.

A total of 320 bromeliads (80 in each area) were sampled during 14 months from 2014 to 2016. Quarterly samplings were carried out in each of the 4 study areas. The collected material was kept in polyethylene bottles.

The water accumulated in the leaves of the bromeliads was sampled with the aid of a 50 mL syringe coupled to a hose. During the sampling, some abiotic parameters of the water were measured, such as pH, temperature (°C), and conductivity ($mS \cdot cm^{-1}$) with a Hanna HI98130 portable probe, while dissolved oxygen ($mg \cdot L^{-1}$) was measured with a digital probe, Instrutherm (MO-910) (Table 1).

Identification was performed using specialized literature such as Huber-Pestalozzi 1955, Tell & Conforti 1986, Wołowski 2011, as well as recent floristic works. All material was analyzed under the Olympus LX35 microscope and photographed with the MicroPublisher QImaging MP5.0-RTV-CLR-10-C camera. Four days after collection, the material was preserved in Transeau solution (Bicudo and Menezes 2006) and deposited in the Herbarium of the Universidade Estadual de Feira de Santana (HUEFS).

The protocol for preparation of the samples of *Phacus orbicularis* Hübner and *Euglena mutabilis* F.Schmitz in a scanning electron microscope (SEM) was based on Ramos et al. (2016). The specimens were initially adhered to a glass coverslip with poly-L-lysine (Sigma, 1:10). Subsequently, the material was dehydrated in acetone series (30%, 50%, 70%, 85%, 95% and 100% for 10 min each). Finally, the material was dried at the critical point (Leica EM CPD030) and the stubs were mounted and coated with a gold layer and examined in MEV (JEOL 6390 LV).

The frequency of occurrence relative (%) of Euglenophyceae in the bromeliads sampled in each area was calculated according to the formula: $F = n \cdot 100 / N$; Where n = number of samples (bromeliads) in which a species was recorded; N = total number of samples analyzed in each area ($N = 80$). Frequency categories were determined according to Matteucci and Colma (1982): > 70%, very frequent; ≤ 70% and > 40%, frequent; ≤ 40% and > 10%, uncommon; ≤ 10%, rare. The frequency absolute corresponds to number of bromeliads in which euglenoids occurred (Table 2).

The distribution of the taxa in Brazil followed Alves-da-Silva and Menezes (2015) (List of Brazilian Flora Species), Duarte et al. (2013), and Araújo (2016).

Results

Astasia comma Pringsheim

New Phytol. 41(3): 177, fig. 3. 1942.

Figure 2A–C

Cells claviform, 20.0–27.5 µm long, 6.5–8.5 µm wide, colourless, hyaline pellicle, semi-rigid, longitudinal strips, rounded anterior pole, slightly acuminate posterior

Table 1. Mean and standard deviation of the abiotic water variables of the bromeliad tanks with presence of Euglenophyta (T = Temperature, C = Conductivity, DO = Dissolved Oxygen).

Species	T (°C)	pH	C ($mS \cdot cm^{-1}$)	DO ($mg \cdot L^{-1}$)
Astasia comma	30.2	5.5	0.37	6.6
Euglena mutabilis	27.1 (± 3.1)	5.9 (± 0.5)	0.22 (± 0.15)	7.6 (± 4.3)
Peranema trichophorum	28 (± 2)	5.8 (± 0.6)	0.18 (± 0.1)	7.6 (± 4.4)
Phacus orbicularis	29.4 (± 1)	5.7 (± 0.2)	0.25 (± 0.12)	4.1 (± 0.8)
P. polytrophos	28.1 (± 3.7)	4.9 (± 0.8)	0.14 (± 0.13)	6.3 (± 3.2)
P. ocellatus	24.4 (± 0.3)	5.2 (± 0.7)	0.11 (± 0.08)	2.7 (± 0.8)
P. wettsteinii	33	3.7	0.09	2.9
Rhabdomonas incurva	32.7 (± 0.4)	5 (± 1.8)	0.08 (± 0.01)	3.2 (± 0.5)

Table 2. Frequency absolute (A) and relative (R) of Euglenophyceae in the bromeliad phytotelmata from Serra da Jiboia (Santa Teresinha), Parque das Dunas (Salvador), Reserva Sapiranga (Mata de São João), and Fazenda Itaberaba (Itaberaba), Bahia state, Brazil. Classification of frequency (C): > 70%, very frequent (VF); ≤ 70% and > 40%, frequent (F); ≤ 40% and > 10%, uncommon (U); ≤ 10%, rare (R).

Species	Reserva Sapiranga			Serra da Jiboia			Fazenda Itaberaba			Parque das Dunas		
	A	R (%)	C	A	R (%)	C	A	R (%)	C	A	R (%)	C
Astasia comma	—	—	—	1	1.25	R	—	—	—	—	——	—
Euglena mutabilis	—	—	—	45	56.25	F	—	—	—	—	—	—
Peranema trichophorum	—	—	—	4	5.0	R	—	—	—	—	—	—
Phacus orbicularis	—	—	—	5	6.25	R	—	—	—	—	—	—
P. polytrophos	6	7.5	R	21	26.25	U	17	21.25	U	17	21.25	U
P. ocellatus	3	3.75	R	—	—	—	—	—	—	—	—	—
P. wettsteinii	—	—	—	—	—	—	—	—	—	1	1.25	R
Rhabdomonas incurva	—	—		—	—	—	—	—	—	2	2.5	R

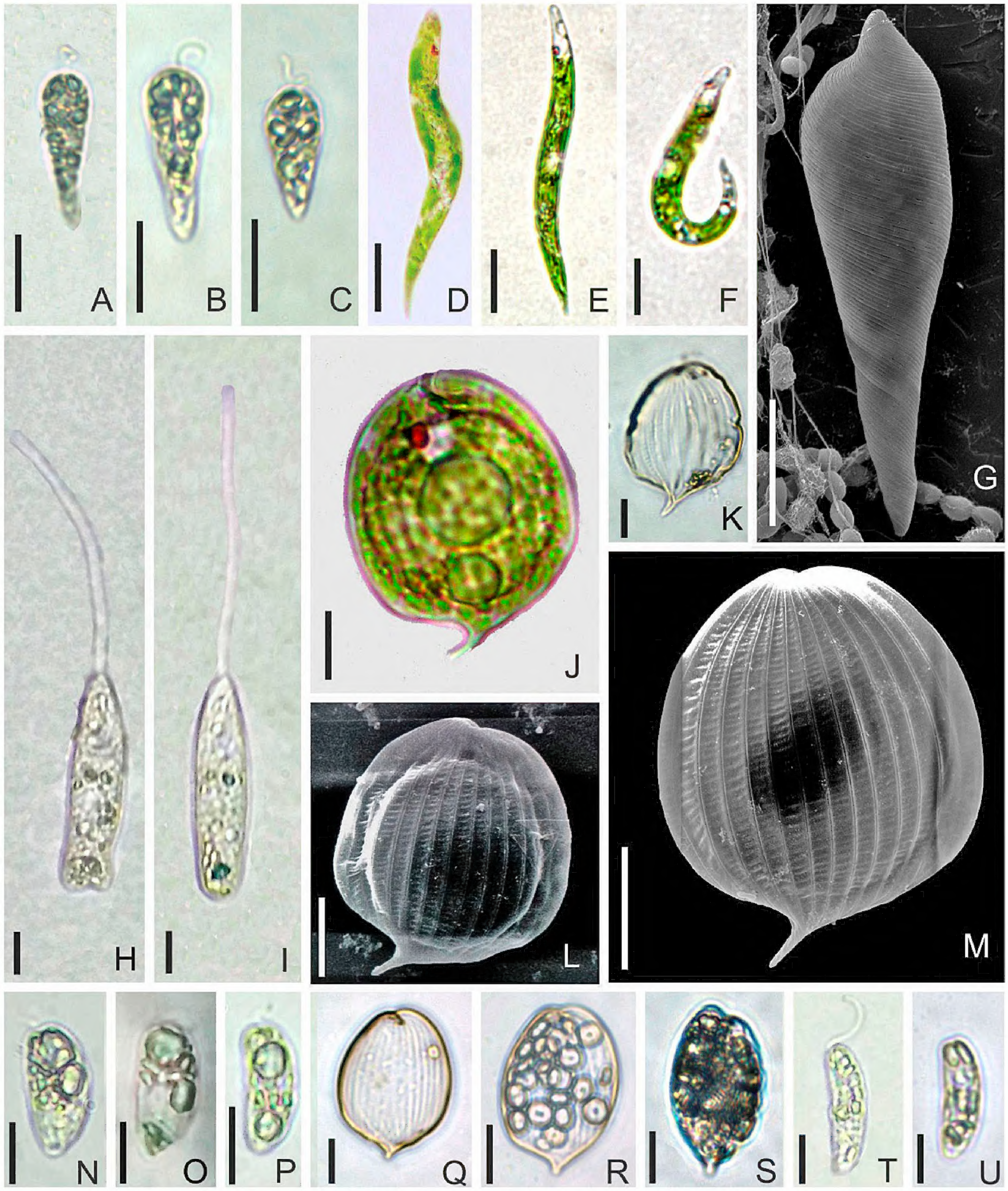

Figure 2. Euglenophyceae of bromeliad phytotelmata from Bahia state, Brazil: **A–C**. *Astasia comma*. **D–G**. *Euglena mutabilis*. **H, I.** *Peranema trichophorum*. **J–M**. *Phacus orbicularis*. **N–O.** *Phacus polytrophos*. **P.** *Phacus wettsteinii* **Q, R**. *Phacus ocellatus*. **S.** Side view of *P. ocellatus*. **T, U**. *Rhabdomonas incurva*. (Bar = 10µm).

pole, numerous paramylon grains of different sizes located predominantly in the anterior region, chloroplasts and stigma not observed; 1 emerging flagellum.

Material examined. Brazil, Bahia, Serra da Jiboia, Santa Teresinha, 14/I/2015, G.J.P. Ramos et al. s/no. (HUEFS 155295).

Geographical distribution in Brazil. First record.

Notes. According to Pringsheim (1942), *Astasia comma* is morphologically close to *A. inflata* Dujardin which differs by presenting shorter flagellum and nucleus difficult to see. Despite this, we consider these features to be unsustainable for separation of both species, since they were also observed in *A. comma*. We consider the cellular form claviform a more relevant feature, since we did not observe a spherical metabolism in this species,

an observation also reported by Pringsheim (1942). We did not observe large morphological variations, only the anterior region going from rounded (most common) to slightly truncated.

Euglena mutabilis Schmitz

Jahrb. Wiss. Bot. 15: 37, pl. 1, fig. 3, 1884.

Figure 2D–G

Cell fusiform-cylindrical, elongated, 50–150 µm long, 7.5–8.5 µm wide, photosynthetic, anterior pole truncated, hyaline pellicle, semi-rigid, thin, longitudinal to slightly helical strips, central nucleus, chloroplasts numerous, discoid, pyrenoid not observed, small paramylon grains, emergent flagellum not observed; stigma present.

Material examined. Brazil, Bahia, Serra da Jiboia, Santa Teresinha, 14/I/2015, G.J.P. Ramos et al. s/no. (HUEFS 224654), 18/VII/2015, G.J.P. Ramos et al. s/no. (HUEFS 224676), 11/IX/2015, G.J.P. Ramos et al. s/no. (HUEFS 224698), 20/XI/2015, G.J.P. Ramos et al. s/no. (HUEFS 224723).

Geographical distribution in Brazil. Distrito Federal, Rio de Janeiro, Rio Grande do Sul.

Notes. *Euglena mutabilis* was commonly found in bromeliad phytotelmata of Serra da Jiboia, often forming large populations. According to Alves-da-Silva and Hahn (2004), this species is generally found in acid environments; however, we found some specimens also in alkaline biotypes. Despite that, we suppose the acidic conditions (pH 5.5–6.5) of the bromeliad phytotelmata were more favorable for the development of *E. mutabilis* in the phytotelmata from Serra de Jiboia since the most specimens were found in such conditions.

Peranema trichophorum (Ehrenberg) Stein

Org. Infusionsthiere 1:76. 1859.

Basionym: *Trachelius trichophorus* Ehrenberg

Synonym: *Peranemopsis trichophora* (Ehrenberg) L.S.Péterfi

Figure 2H–I

Cell cylindrical-elongated, 50–55 µm long, 10–12 µm wide, colorless, metabolic, acuminate at the anterior pole, broadly truncated-rounded posterior pole, hyaline, thick, flexible pellicle, spiral strips, chloroplasts and stigma not observed; rounded paramylon grains; 2 flagella, unequal, the largest approximately of the same length of the cell.

Material examined. Brazil, Bahia, Serra da Jiboia, Santa Teresinha, 14/I/2015, G.J.P. Ramos et al. s/no. (HUEFS 224662), 18/VII/2015, G.J.P. Ramos et al. s/no. (HUEFS 224690), 11/IX/2015, G.J.P. Ramos et al. s/no. (HUEFS 224701).

Geographical distribution in Brazil. Paraná, Rio de Janeiro.

Notes. According to Wołowski (2011), *Peranema trichophorum* is probably a cosmopolitan species. Although it has also been reported in a phytotelm habitat in the Paraná region (Duarte et al. 2013), this species was rarely found in the bromeliads of Serra da Jiboia, occurring in only a few plants (4).

Phacus orbicularis Hübner

Prog. Realgym. Stralsund., p. 5, fig. 41, 1886.

Figure 2J–M

Cell broadly ovate to globose, 30–42 µm long, 30–32 µm wide; photosynthetic, rounded at the anterior pole, apical view triangular, with rounded angles; posterior pole abruptly attenuated in caudal process conical; pellicle with longitudinal strips, transverse grooves between the longitudinal grooves; chloroplasts discoid; 1–2 paramylon grains, 1 central discoid and another eccentric.

Material examined. Brazil, Bahia, Serra da Jiboia, Santa Teresinha, 14/I/2015, G.J.P. Ramos et al. s/no. (HUEFS 224666).

Geographical distribution in Brazil. Amazonas, Pará, Rondônia, Maranhão, Distrito Federal, Mato Grosso do Sul, Mato Grosso, Rio de Janeiro, Paraná, Rio Grande do Sul, Santa Catarina.

Notes. Morphologically, *Phacus orbicularis* resembles *Phacus pleronectes*, (Müller) Nitzsch ex Dujardin but this differs in that it does not present transverse grooves between the longitudinal grooves. In general, *P. orbicularis* was a rare species in the bromeliads of Serra da Jiboia, occurring in only 5 bromeliads in the period of January 2015. This is the first record of the species for the northeastern region of Brazil.

Phacus polytrophos Pochmann

Archiv für Protistenkunde 95(2): 128, fig. 15a–d. 1942.

Figure 2N–O

Cell approximately elliptical, 18.8–23.7 µm long, 7.5–8.8 µm wide; photosynthetic, rounded at the anterior pole, attenuated posterior pole with short basal projection; hyaline pellicle, rigid, delicate strips, difficult to visualize, numerous chloroplasts, discoid, pyrenoid not observed, 1–2 paramylon grains, elliptic discoid, oblique position in the cell, 1 greater, anterior, 5.0 –11.5 µm, another smaller, posterior, 4.0–7.5 µm long, not always present;1 flagellum; nucleus, stigma not observed.

Material examined. BRAZIL, BAHIA, Serra da Jiboia, Santa Teresinha, 14/I/2015, G.J.P. Ramos et al. s/no. (HUEFS 224653), 18/VII/2015, G.J.P. Ramos et al. s/no. (HUEFS 224676), 11/IX/2015, G.J.P. Ramos et al. s/no. (HUEFS 224698), 20/XI/2015, G.J.P. Ramos et al. s/no. (HUEFS 224713); Parque das Dunas, Salvador, 14/I/2015, G.J.P. Ramos & M.A. Santos s/no. (HUEFS 224729), 25/V/2015, G.J.P. Ramos et al. s/no. (HUEFS 224750), 04/IX/2015, G.J.P. Ramos et al. s/no. (HUEFS 224769), 27/01/2016, G.J.P. Ramos et al. s/no. (HUEFS 224796); Fazenda Itaberaba, Itaberaba, 21/01/2016, G.J.P. Ramos et al. s/no. (HUEFS 170355), 08/V/2015, G.J.P. Ramos & M.A. Santos s/no. (HUEFS 224800), 21/08/2015, G.J.P. Ramos et al. s/no. (HUEFS 224802), 08/01/2016, G.J.P. Ramos et al. s/no. (HUEFS 225724), Reserva Sapiranga, Mata de São João, 20/12/2014, G.J.P. Ramos et al. s/no. (HUEFS 225716), 15/05/2015, G.J.P. Ramos et al. s/no.

(HUEFS 225717), 28/08/2015, G.J.P. Ramos et al. s/no. (HUEFS 225722).

Geographical distribution in Brazil. Amazonas, Tocantins, Goiás, Paraná, Rio Grande do Sul, São Paulo.

Notes. According to Alves-da-Silva and Bicudo (2009), *Phacus polytrophos* is morphologically close to *P. granum* Drežepolski; however, the latter species differs by having longitudinally arranged strips and the presence of 2 or more paramylon grains, with approximately rectangular angles. *Phacus polytrophos* was the only species found in all 4 species of bromeliads studied: *A. nahoumii*, *H. littoralis*, *A.* cf. *lingulatoides*, and *H. stellata*.

***Phacus wettsteinii* Drežepolski**

Kosmos 50(1A): 267, pl. 3, fig. 122. 1925.

Figure 2P

Cell approximately elliptical, 16.8–18.8 µm long, 6.2–8.7 µm wide; photosynthetic, rounded at the anterior pole, asymmetrical, posterior pole slightly acuminated; hyaline pellicle, rigid, delicate longitudinal strips, difficult to visualize; numerous chloroplasts, discoid, pyrenoids absent, 2 paramylon grains, discoid, 1 greater anterior, 5.0–5.5 µm long, another smaller posterior, 3.5–4.0 µm long, not always present, rounded nucleus, eccentric; 1 flagellum; stigma not observed.

Material examined. Brazil, Parque das Dunas, Salvador, 14/I/2015, G.J.P. Ramos & M.A. Santos s/no. (HUEFS 224737).

Geographical distribution in Brazil. Rio Grande do Sul, São Paulo.

Notes. *Phacus wettsteinii* is morphologically close to *P. granum* Drežepolski, and it is often difficult to separate these species. However, a useful feature to separate both species is the morphology of the paramylon grains. According to Araújo (2016), *P. granum* has 2 or more rod-shaped paramylon grains, generally with approximately rectangular angles, whereas *P. wettsteinii* has 1 or 2 paramylon grains usually discoid (may still be elliptical).

In the present study, this species was considered rare, occurring only in a bromeliad of the Parque das Dunas. Little is known about its geographic distribution in Brazil, with records only for the states of Rio Grande do Sul and São Paulo (Alves-da-Silva and Menezes 2015, Araújo 2016). This is the first record of the occurrence of the species for the northeast region of the country.

***Phacus ocellatus* (Pringsheim) Marin & Melkonian**

Protist 154: 101. 2003.

Basionym: *Hyalophacus ocellatus* Pringsheim

Figure 2Q–S

Cell ovate, 30–32 µm long, 23–34 µm wide; colorless, rounded at the anterior pole; rounded angles; posterior pole attenuated in caudal projection, conical, slightly curved; rigid pellicle, longitudinal strips; chloroplasts absent; numerous paramylon grains.

Material examined. Brazil, Bahia, Reserva Sapiranga, Mata de São João, 20/12/2014, G.J.P. Ramos et al. s/no. (HUEFS 225714), 15/05/2015, G.J.P. Ramos et al. s/no. (HUEFS 225720), 28/08/2015, G.J.P. Ramos et al. s/no. (HUEFS 225721).

Geographical distribution in Brazil. Rio Grande do Sul.

Notes. *Phacus ocellatus* was one of the few algal representatives found in the bromeliad tanks of the Reserva Sapiranga, and in some cases, it was the only recorded species. In these bromeliads, it was common to find several leaves in decomposition.

***Rhabdomonas incurva* Fresenius**

Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft 2: 230, pl. 10, fig. 46-47. 1858.

Figure 2T, U

Cell cylindrical, slightly arcuate, 25–26.5 µm long, 5.0–6.5 µm wide, colorless, rounded or slightly truncated at anterior pole, rounded posterior pole; hyaline pellicle, rigid, longitudinal strips; chloroplasts and stigma absent; numerous paramylon grains, rounded to elliptical; 1 emergent flagellum, 5–7 µm long.

Material examined. Brazil, Bahia, Parque das Dunas, Salvador, 14/I/2015, G.J.P. Ramos & M.A. Santos s/no. (HUEFS 224729, HUEFS 224737).

Geographical distribution in Brazil. Amazonas, São Paulo.

Notes. *Rhabdomonas incurva* is a species rarely recorded in Brazilian territory with reports of its occurrence only for the states of Amazonas (Bittencourt-Oliveira 1997) and São Paulo (Araújo 2016). This is the first time the species is being recorded for the northeast region of Brazil.

Discussion

The presented study is the first inventory for the class Euglenophyceae in a phytotelm habitat in Brazil, and contributes to the knowledge expansion of the geographic distribution of taxa in Bahia state, especially in areas of Restinga, Atlantic Forest, Caatinga, and rocky outcrops. All taxa are being registered for the first time to Bahia and 1 species (*A. comma*) is a new record for Brazil (Fig. 3).

The richness was greater in the bromeliads from the Serra da Jiboia (5 species), followed by the Parque das Dunas (3), Reserva Sapiranga (2), and Fazenda Itaberaba (1). *Phacus polytrophos* was the only species found in all the studied areas. In relation to the seasons, the richness of taxa was highest during the hottest periods (December 2014, January 2015, November 2015, and January 2016), with some taxa such as *A. comma*, *P. wettsteinii* and *R. incurva* exclusive to these periods.

The most representative genus in species number was *Phacus* (4 species): *P. polytrophos*, *P. wettsteinii*, *P. orbicularis,* and *P. ocellatus*. In Brazil, these species have been found in shallow pools and acidic water bodies (Alves-da-Silva and Torres 1994, Alves-da-Silva and Bridi 2004, Alves-da-Silva and Bicudo 2009, Alves-da-

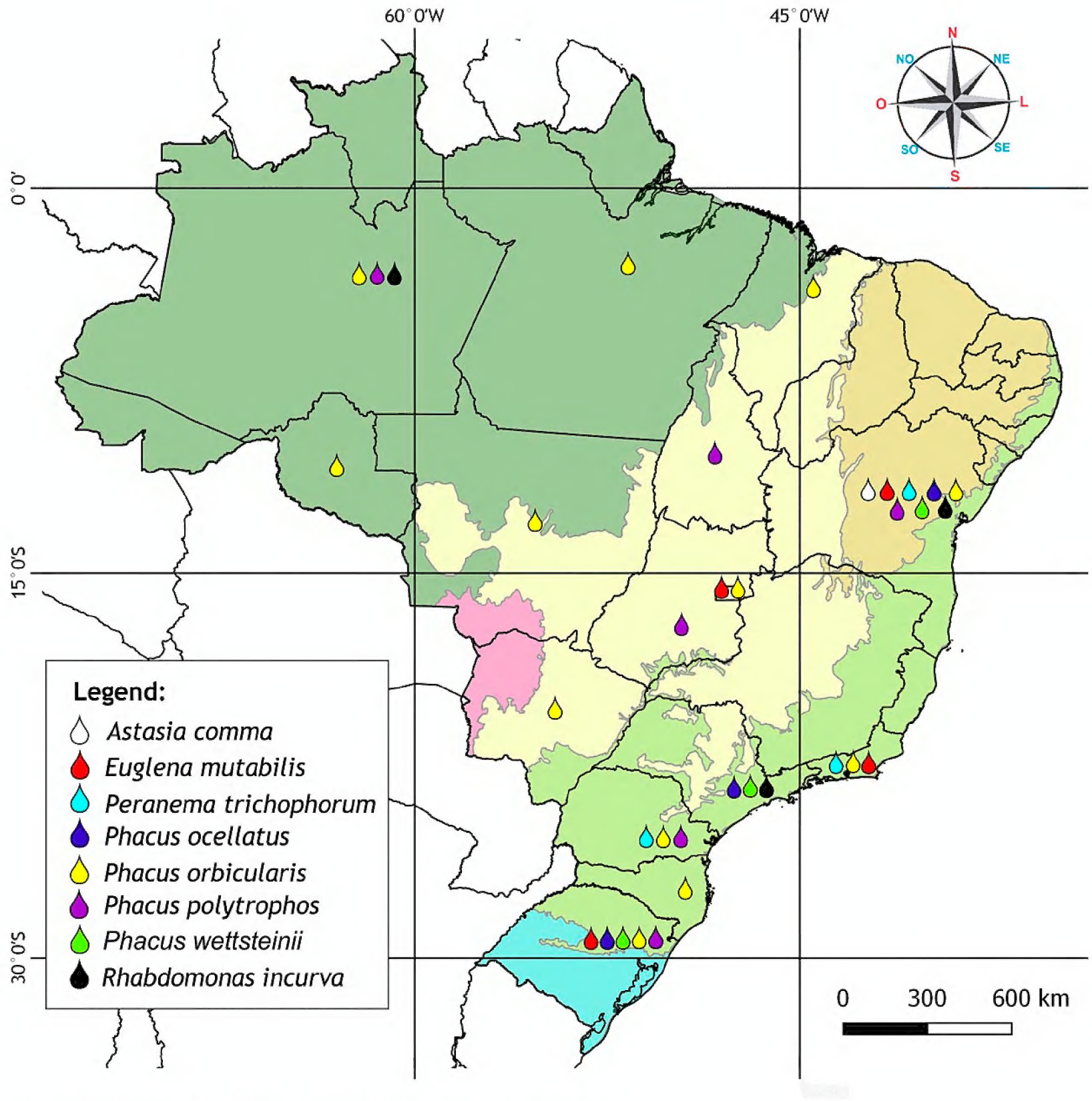

Figure 3. Geographic distribution of 8 species of Euglenophyceae in Brazil.

Silva et al. 2011), as was verified in bromeliad tanks.

The pH of the bromeliads with euglenophytes was predominantly acidic (pH <6.6) in the 4 areas, except a bromeliad from the Serra da Jiboia, which presented pH 7.6 during the November 2015 season. *Euglena mutabilis* was the only euglenoid found in alkaline and acidic conditions. As for the other water variables, there was a predominance of high temperatures, a low conductivity mainly in bromeliads exposed to the sun, and dissolved oxygen was very variable, ranging from very low values (usually in the shaded areas, DO < 4 $mg \cdot L^{-1}$) to very high values in areas exposed to the sun (DO > 8 $mg \cdot L^{-1}$).

In relation to the frequency of occurrence, *E. mutabilis* was the only species considered frequent (56.2%) in the Serra da Jiboia. *Phacus polytrophos*, although it was the only species found in the 4 areas, it was considered uncommon in both the Serra da Jiboia (26.2%) and the Parque das Dunas and Itaberaba (21.2%), and rare in the Reserva Sapiranga (7.5%). The other taxa were considered rare with frequency of occurrence less than 7% (Table 2).

According to Sanders (1991), colorless euglenoids (heterotrophic) are commonly found in water bodies rich in organic matter, where they feed on bacteria and organic solutes. Although we did not measure nutrient concentrations in the tanks, we found 3 colorless species: *P. ocellatus*, *P. trichophorum*, and *A. comma*. Among those, the most common species was *P. ocellatus,* occurring in bromeliads from Reserva Sapiranga. In these bromeliads, it was quite common to find several decomposing leaves in the tanks, which probably contributed to raising the rates of organic matter, favoring the appearance of that species.

According to Brouard et al. (2012), mixotrophic Euglenophyceae are often found in partially or totally shaded bromeliads absorbing more organic than inorganic nitrogen. However, we suppose that sunlight has a greater influence on the diversity of Euglenophyceae (especially pigmented ones) more than the concentration of organic matter in bromeliad tanks. In our study, the exposed areas were the ones that presented the greatest richness, especially in the Serra da Jiboia, where it was common to observe huge populations, mainly *E. mutabilis*, being in some cases 1 of the predominant species in the tanks. Laessle (1961) reported that in bromeliads of Jamaica subject to high sun exposure were found

Lepocinclis spirogyroides Marin & Melkonian (formerly *E. spirogyra* Ehrenberg) and *Trachelomonas* sp., the latter being considered very abundant in tanks. Thus, it is possible that in shaded bromeliads the tendency is to find mainly colorless specimens, whereas in bromeliads exposed to the sun, it is more common to find both pigmented and colorless individuals, although the latter in a few quantities.

Finally, it is important to emphasize the need for new taxonomic investigations on the class Euglenophyceae in Bahia state, as well as other areas of northeast Brazil, where the knowledge of the group is still incipient and usually restricted to some checklists.

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Authors' Contributions

GJPR, SMAS, CEMB and CWNM wrote the manuscript, and GJPR and CWNM participated in the fieldwork.

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